State Water Survey Division
HAZARDOUS WASTE RESEARCH AND INFORMATION CENTER
P.O. Box 5050, Station A
Champaign, Illinois 61820

Illinois Department of
Energy and Natural Resources

SWS/HWRIC Report 003

HAZARDOUS WASTE RESEARCH AND INFORMATION CENTER

FY'85 PROGRESS REPORT

May 1985

Illinois Department of Energy and Natural Resources

Hazardous Waste Research and Information Center (HWRIC)

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Michael J. Barcelona, Acting Director

Wendy J. Garrison, Research Scientist

ACKNOWLEDGEMENTS

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The logo chosen for HWRIC symbolizes the interrelationship between the technological, societal and environmental forces at work in our world. Major changes and advances in either one of these three spheres of activity exert direct influences on the others. The complexity of hazardous waste related problems demands that all sections of society work together with the understanding that action based on reliable information will lead to solutions to these problems.

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EXECUTIVE SUMMARY

The **Hazardous Waste Research and Information Center (HWRIC)** is an inter-divisional program of ENR hosted by the Water Survey. Its mandate is to provide technical support, research and services towards the development of a comprehensive hazardous waste management strategy for the state. The program was created as part of the Governor's Chemical Safety Research Initiative in July of 1984 and it complements the efforts of the Illinois Environmental Protection Agency's **Toxicology Testing Program** and the Illinois Department of Public Health's **Health and Hazardous Substances Registry** in this regard. HWRIC has three program areas: Research, Information, and Industrial and Technical assistance which are working towards solutions to the problems of hazardous waste management by: improving the information base on current waste management practices and environmental consequences, providing high quality technical products to government, industry and public interest groups and encouraging industry to adopt alternatives to land disposal of hazardous wastes. The effectiveness of the management strategy of the waste by-products of our society will eventually rest on reliable information. Much of the available information is inadequate. Research in a variety of scientific and engineering disciplines provides the key to the development of this strategy.

In the past ten months, HWRIC has begun to develop into a positive force towards the achievement of its goals. Major accomplishments are detailed below:

High quality scientific and engineering staff members have

been recruited to provide the nucleus about which the program will continue to develop in the coming year.

The functional design of a facility to house HWRIC activities has been completed with a Hazardous Materials Laboratory as its focus. The laboratory will provide valuable research and services support to HWRIC programs, industry and state agencies involved in the assessment and solution of waste management and environmental problems resulting from waste handling operations.

An active research program has been initiated to assess and identify solutions to Illinois' hazardous waste management problems. The program currently supports projects to:

Improve the accounting of current waste handling practices and identify alternative management options to land disposal;

Inventory past and present land disposal operations in the state;

Assess the quality of ground water resources emphasizing the potential effects of hazardous waste management facilities towards the development of a ground water protection plan for the state;

Assess the impacts of hazardous materials on the atmospheric resources of the state, particularly those which result from

waste incineration and identify future research and monitoring needs;

Assess the status of the practice of underground injection of hazardous wastes; and

Examine the current categorization scheme for **special wastes** and make recommendations for a unified waste classification scheme.

Research progress to date has disclosed that Illinois has many hazardous waste management problems in common with other states. The magnitude and complexity of the difficulties in: tracking waste generation, handling and disposal, identifying hazardous constituents in waste mixtures and assessing the available technologies which will reduce waste generation and minimize land disposal underscore the need for an expanded research effort. Particular emphasis must be put on the management of high-volume, high hazard waste streams which have been encountered in disposal site cleanup tasks. The state has actually become a waste generator by assuming this responsibility. On-site treatment or destruction processess are favored as they entail less hazard compared to continued landfilling. Also, though a large amount of data is available on the quality of our atmosphere and ground water supplies, the detail and state-wide coverage of the information will permit only limited conclusions on the impacts of waste treatment or disposal on these resources. Here again, expanded research efforts will enable the more accurate assessment of regional air or water quality

problems as well as the monitoring and rehabilitation technology needs for the future.

Waste classification and handling regulations may be improved by a comprehensive evaluation of specific precautions for treatment and disposal activities appropriate for the actual hazard involved in these operations. Center staff are working on evaluation and implementation approaches for improved waste classifications in order to insure that bans on hazardous waste landfilling have the desired effect of reducing waste generation and environmental impacts.

The Center is developing the most comprehensive state information source on waste generation, treatment and disposal in order to better focus attention on potential problem areas. Cooperation with other agencies, industry and the public have been very fruitful in this development effort. To supplement this information, Center staff have participated in multi-state efforts to deal with the hazardous waste problem and extra benefits will result from these joint activities. The development of the education, information transfer and Industrial and Technical Assistance programs of HWRIC will benefit from this information base. We are just getting started in our scientific and engineering pursuit of the solutions to Illinois' hazardous waste problems.

I. Mission and Objectives of HWRIC

The Hazardous Waste Research and Information Center (HWRIC) was established within ENR as a part of Governor Thompson's Chemical Safety Research Iniative. In this role, HWRIC's mission is to provide assistance to industry, the public and state and local government through research and information dissemination to reduce environmental and health risks associated with hazardous waste generation and management. The technical activities of HWRIC together with the Toxicology Testing Program of the Illinois Environmental Protection Agency will encourage the development of a balanced waste management strategy which has as its basis reduced hazardous waste generation and alternative waste handling techniques to land disposal.

The major goals of HWRIC are addressed by its three program areas:

RESEARCH - Problem assessment and problem solving investigations needed to improve the accounting of current HW handling practices and to more accurately focus technical assistance and service efforts in support of a viable waste management strategy for the state.

INFORMATION - The preparation and distribution of high quality technical information needed to permit government, industry, and the public to work cooperatively towards solutions to HW management problems.

INDUSTRIAL AND TECHNICAL ASSISTANCE - Engineering studies and technical advisory activities are needed to provide the basis for determining feasible waste management practices which are environmentally sound and encourage wise economic development.

HWRIC's program areas have information collection and transfer as common elements. ENR began this work in the spring of 1983 with the administration of the Hazardous Waste Research Fund (HWRF) which is supported by collections of fees on the treatment and disposal of hazardous wastes. Research supported by the HWRF has focused on both the prioritization of potential environmental impacts of HW related activities (1) and the evaluation of alternative technologies for liquid HW treatment and disposal (2). The current research program is detailed in Section III of this report. All of the projects have been selected on the basis of high priority needs for information and potential environmental impacts, waste management practices and the identification of alternative waste handling options for the state. As the primary HW program in ENR, HWRIC staff have undertaken priority research contained in the initial plan for action published in July of 1984 (3) in addition to administering the research tasks identified by the 1984 session of the 83rd Illinois General Assembly. The emphasis of HWRIC research activities is to address Illinois' specific problems with the use of all available information from other states and the Federal Government.

The industrial and technical assistance program area of HWRIC has assumed the responsibility to work cooperatively with industry in implementing waste reduction, advanced treatment and disposal technologies as mandated by the Hazardous Waste Technology Exchange Act (4). The summary results of HWRIC research, information and assistance efforts will be reported each year to the Hazardous Waste Advisory Council which was created in 1983 (5). Specific research products will be supplied to the Governor, legislature and government agencies on a demand basis. In this respect, HWRIC activities complement

the ongoing Toxics Control Strategy of the Illinois Environmental Protection Agency and the Health and Hazardous Substances Registry of the Illinois Department of Public Health.

The HWRIC program is unique in that it provides a single source of technical advice, information and assistance. Since ENR's involvement does not entail regulatory or enforcement considerations we are in a unique position to provide an impetus to the development of state hazardous waste management strategy.

References

1) J. P. Gibb, M. J. Barcelona, S. C. Schock, and M. W. Hampsten, 1984 Hazardous Waste in Ogle and Winnebago Counties: Potential Risk via Ground Water Due to Past and Present Activities. HWRF Project No. 83/4001. State Water Survey Contract Report #336. 66 pp. February, 1984.

2) R. Hunt, N. Artz, J. Sellers, R. Young, R. Welch, T. Ferguson, T. Lapp, R. Kakarlapudi, F. Hopkins, W. Frerichs, and K. R. Reddy, 1984. The Development of Detailed Characterization of Liquid Hazardous Waste Streams Generated by Illinois Industries. HWRF Project No. 83/1201. Franklin and Associates, Midwest Research Institute Report prepared jointly with ENR staff. 68 pp. March, 1984.

3) ENR 1984. Hazardous Waste Research and Information Center Plan for FY'85. SWS/HWRIC Report 001. 33 pp. & Appendices. July, 1984.

4) Illinois General Assembly 1984 - Hazardous Waste Technology Exchange Program P.A. 83-1436.

5) Illinois General Assembly 1983 - Hazardous Waste Advisory Council, P.A. 83-983.

II. STRUCTURE OF HWRIC AND MANAGEMENT ACTIVITIES

HWRIC Structure

HWRIC is an interdivisional program of ENR hosted by the Water Survey Division. It's management structure permits the experience and capabilities of over four-hundred scientists and engineers to be focused on the most critical information gaps which must be filled towards the development of a comprehensive waste management strategy for Illinois.

Program activities are supervised by the Director of ENR and the Chief of the Water Survey who acts as the Chairman of the Policy and Program Governing Board. The board consists of the following membership:

HWRIC GOVERNING BOARD

CHAIRMAN -	Stanley A. Changnon, Jr.	Chief, Water Survey
	Frank M. Beaver	Director, Energy & Environ. Affairs
	Morris W. Leighton	Chief, Geological Survey
	Paul G. Risser	Chief, Natural History Survey
	R. Bruce McMillan	Director, State Museum
NON-VOTING MEMBERS -	Thomas A. Pigati	ENR Administration
	Michael J. Barcelona	Acting Director, HWRIC

The Governing Board was formed in June of 1984. It met to discuss Center programs in August and December of last year in addition to supplying periodic review of various initiatives. Valuable direction and evaluation of technical staff recruitment has required the extensive involvement of members of the Governing Board. Upcoming meetings are scheduled in May to evaluate the implementation plan for HWRIC's data base management system and in June to review the proposed FY'86 budget and program activities.

Additional program advisory functions to the Director of HWRIC are provided by internal and external groups, the Research Advisory Committee and the Program Adivsory Panel. The memberships of these groups are outlined below:

HWRIC RESEARCH ADVISORY COMMITTEE

Keros Cartwright	Geological Survey
Robert W. Gorden	Natural History Survey
James E. King	State Museum
James P. Gibb	Water Survey
Ram Reddy	ENR

HWRIC PROGRAM ADVISORY PANEL

Robert Ginsburg	Citizers for a Better Environment
S. Gary	Scientific Control Laboratories
Sue Ramirez	Environmental Toxicology Program IL Dept. of Public Health
Morton J. Klein	IIT Research Institute
Thomas L. Reid	IL Manufacturers Assoc.
Gretchen Monti	League of Women Voters of Illinois
Richard Lanyon	Metropolitan Sanitary District of Greater Chicago
John C. Marlin	IL Pollution Control Board
Richard S. Engelbrecht	Civil Engineering Lab, University of Illinois
Catherine C. Patriquer	Nalco Chemical Company
Sidney M. Marder	IL State Chamber of Commerce
Robert G. Kuykendall	Illinois EPA

The Research Advisory Committee was formed in July of 1984. The committee met in August, October and November of 1984 to provide technical input to the Center's research program. The Committee also provided review of major external contractors for the research program in addition to other technical input. Members of the Committee aided in both the development of the functional description of the Hazardous Materials Laboratory (1) and in the screening of candidates for senior core staff positions.

The Program Advisory Panel provides critical external review of HWRIC program development activities. The panel met as a group in January of 1985. Their perspective supported the role of HWRIC as a neutral highly technical source of information on critical HW issues. The panel will meet in June or July of this year to review both the progress of the first year operations of the Center and the plans for next fiscal year.

The relationship of HWRIC advisory and governing groups to the management structure of the Center is depicted in Figure 1.

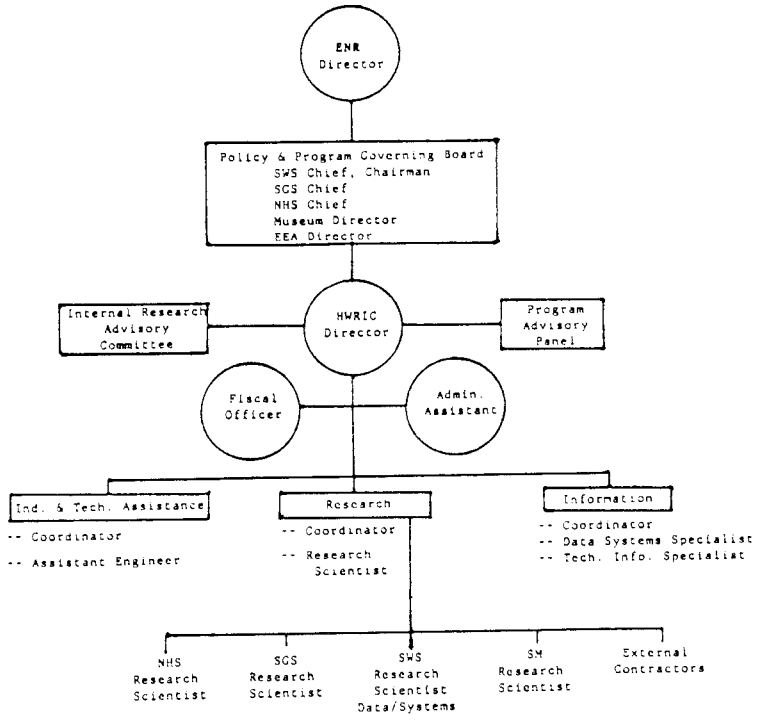

Figure 1 shows the overall organizational structure of HWRIC including staffing details. Core staff include: the Director, a Fiscal Officer and an Administrative Assistant/Secretary as well as the scientific and engineering staff of the program areas. Divisional staff members are hosted by four of the five divisions of ENR. They are active participants in the hazardous waste research activities of HWRIC and their respective divisions. The effectiveness and vigor of the research programs are strengthened by contractual arrangements with external groups. This structure enables HWRIC to serve the state as a research organization with an active research complement.

Management Activities

Recruitment

The development of an experienced, technically competent research staff to guide and coordinate HWRIC programs was based on an international search for qualified scientists and engineers. The search was initiated in September of 1984 following executive permission to exempt the positions from the current state hiring freeze. Position announcements were placed in state, local and international scientific publications in a range of disciplines which deal with environmental and waste-management issues. Over 200 applications were received in response to the position announcement by the November 30, 1984, application deadline. Applications were screened by the Governing Board, the Research Advisory Committee and senior staff in the Divisions to select the five top candidates for each position which would be afforded personal interviews.

Candidate interviews for the Director, program area coordinators and other staff began in December of 1984 and are in the final stages of completion at this time. The current staff profile is shown in Table 1 with reference to the positions detailed in Figure 1.

TABLE 1

Current Staff Profiles of HWRIC

Core Position	Individual	Qualifications
Director - (ACTING)	Dr. Michael J. Barcelona	B.A. Chemistry M.S. Chemistry Ph.D. Marine Chemistry
	Dr. David L. Thomas	(Start May 20, 1985)
Fiscal Officer *	Ms. Lynda L. Warren	B.A. Finance M.S. Finance (In Progress)
Administrative Assistant	Ms. Katherine M. Day	
Industrial & Technical Assistance Coordinator	Mr. Frederick L. Doll	B.A. Chemistry M.S. Water Chemistry Registered Engineer
Industrial Assistance Engineer	Recruitment in Final Stages	
Information Program Coordinator	Recruitment in Final Stages	
Information Specialist	Recruitment in Final Stages	
Data Systems Specialist	Recruitment in Final Stages	
Research Program Coordinator	Dr. Gary D. Miller	(Start June 3, 1985)
Research Scientist	Ms. Wendy J. Garrison	B.A. English M.S. Biology
Div. Research Position	**Individual**	**Qualifications**
Geological Survey	Mr. Edward Mehnert	B.A. Civil Engineering M.S. Civil Engineering
Natural History Survey	Dr. Phillipe E. Ross	B.A. General Science M.S. Limnology (Biology) Ph.D. Limnology (Biology)
State Museum	Dr. Craig E. Colten	B.A. Major Geography M.S. Geography Ph.D. Geography
Water Survey	Ms. Susan C. Schock	B.A. Geoscience M.S. Geochemistry/Geology

* Position is supported by overhead/indirect cost earnings

Recruitment of the staff was protracted by the need for thorough review of applications and the scheduling difficulties involved in evaluating a large number of out-of-state applications. The process has been rewarding in that we have identified the most capable individuals available for HWRIC activities. The resident and incumbent scientists provide the nucleus about which HWRIC will continue its development.

Planning for the Hazardous Materials Laboratory and Data Handling System

HWRIC currently occupies leased office space adjacent to the Water Resources Building on the campus of the University of Illinois at Urbana-Champaign. The full development of a balanced program of research and services on HW management issues will require secure waste-handling and modern analytical facilities in order to provide specialized chemical and engineering support for HWRIC activities. Currently there are inadequate waste containment and laboratory facilities in state government for the evaluation of treatment technology efficiency and for the identification of hazardous components in complex waste mixtures.

HWRIC staff anticipated the need for facilities support and responded with a feasibility study which identified the functional capabilities that the Hazardous Materials Laboratory (HML) should provide (1). The functional design was developed with the aid of the staff of the IEPA and the Capital Development Board (CDB) in September of 1984. The main purpose for the document was to provide input for the architectural and engineering design of the HML which will be supported by the $200,000 in CDB planning and construction funds budgeted in FY'85. Several meetings were held in both the fall of 1984 and early 1985 with members of the Governor's staff, CDB, the Bureau of the Budget and the IEPA. Preliminary estimates for the design and construction

of the HML average approximately $8 to 10M and the release of the planning funds is expected shortly. We expect that a detailed schematic design will be completed during the summer and construction should begin in FY'86. In the interim HWRIC will maintain the leased facility and its current postal address.

The data handling needs of HWRIC are prodigious. In addition to the growing regulatory data base on hazardous waste generation, handling and disposal in Illinois there has been an explosion in the sources and detail of available information on alternative management technologies and environmental impacts. HWRIC is currently handling over 25 large data bases with the prospect of developing even larger sets of data which pertain directly to the Illinois situation. Computerized data handling is essential to the effective transfer of useful information to a variety of user-groups. Currently, HWRIC staff and contractors employ the use of at least 8 large mainframe computers and over 30 microcomputers. HWRIC staff have coordinated the release of regulatory data with the Land Pollution Division of IEPA. Master data tapes are maintained by the Center to ease the demands of frequent data requests on IEPA data processing staff.

The optimal design for the future hardware and software facilities of HWRIC is being developed by the joint efforts of staff and consultants. The principal criteria for the design are: data security, rapid data handling and post-processing operations and the flexibility to handle both routine fiscal and waste management accounting data and the interchange of permitted data sets between computer systems. The draft report of the consultant is currently under review by HWRIC and ENR staff and a decision on the implementation of the data base management system will be made in May of 1985 with the consultation of the Governing Board.

External Contacts

HWRIC staff have provided information on the scope of the Center activities to a wide variety of public and private groups associated with hazardous waste management efforts. State government groups in California, New York, New Jersey, Michigan and North Carolina, involved in research, regulation or technical assistance have been most receptive to information on the development of Illinois' programs. In Illinois, formal presentations have been made to groups of students, continuing-education professionals, public citizens, industry and academic professionals as well as administrators from colleges and universities. A partial list of the completed and scheduled public presentations is included in the references (2-9). In all cases, the audiences were enthusiastic about HWRIC's approach to complex hazardous waste management research and service issues. These activities will be expanded in the coming year as the Industrial and Technical Assistance and Information Program develop.

In addition to the formal presentations noted above, HWRIC staff have initiated contacts with representatives of midwest waste exchange programs to explore the possibilities for expanded recycle, reclamation and re-use of waste materials in other applications. This is a promising direction for future activities within the realm of waste reduction options. HWRIC was also represented at a workshop for state industrial assistance programs which was held recently (10). Since a number of industrial states have begun cooperative efforts with industry towards more effective waste management strategies, Illinois will have the benefit of a wide variety of state-experiences in the development of its programs.

Phased Development Plan

The FY'85 Plan for Action described the phased development plan for HWRIC in the initial 2 to 3 years of operation. Phase 1 dealt with the initial development of the information base while Phase 2 signalled the fully operational phase of HWRIC programs. There were two main divisions in the development strategy: implementation of the Data Base Management System in mid-Phase 1 and the establishment of the HML as the beginning of Phase 2 in 1986-87.

Figure 2 describes the major tasks in the various program areas which are planned with the initial phase of HWRIC program development. The major management tasks are progressing according to the plan. Recruitment processes have slowed the formal initiation of the Information and Industrial Assistance program activities. It is imperative that we have correct, up-to-date information ready for release before these activities proceed much further. Research projects are in progress in the high priority task areas in addition to the research projects initiated by the legislature. These research projects provide the needed verification of existing data as well as new information for program development.

In the problem assessment area, the projects deal primarily with the usefulness of existing regulatory data towards the identification of: high-volume, high-risk waste streams and the options which exist for alternative treatment or disposal techniques, and the potential impacts of hazardous waste related activities on the quality of air and water resources. The scale of these projects is at the statewide and industry-wide levels which is about the limit which the data will support. These activities will greatly improve our perspective on various critical problem areas in waste and natural resource management. In FY'86 and '87 the most promising solutions to the problems

will be pursued.

Problem solving research projects focus on the evaluation of current waste categorization and disposal activities with an emphasis on identifying more effective measures where appropriate. Clearly, once the problems with current waste generation and management strategies are defined, we will be in a better position to develop a long-term strategy for waste management in tune with environmental protection. With the state responsibility for cleanup at a number of large disposal or treatment sites, the identification of minimally disruptive on-site cleanup options will be a major thrust in future years.

Detailed descriptions of current research projects are provided in Part III of this report.

References

1) ENR 1984 Hazardous Materials Laboratory Feasibility Study, SWS/HWRIC Report 002, 36 pp.

2) "ENR's Hazardous Waste Research Program - New Directions" talk at Working Together to Manage Hazardous Wastes, Bismark Hotel, Chicago, IL, May 23, 1984.

3) "Hazardous Waste Management and Ground Water Resources of Illinois" talk at ACS Student Affiliates Meeting, Noyes Laboratory, University of Illinois, Urbana-Champaign, September 19, 1984.

4) "The Hazardous Waste Research and Information Center" talk at Society for the Scientific Surveys, Natural Resources Building, University of Illinois, Urbana-Champaign, October 9, 1984.

5) "Hazardous Waste Research in Illinois" talk presented at meeting of the Illinois Ground Water Association, Holiday Inn, Springfield, Illinois, October 25, 1984.

6) "State Experiences with Ground Water Quality Programs: Illinois" talk at Waste Tech '84, National Solid Wastes Management Association, Adam's Mark Hotel, Houston, Texas, October 29, 1984.

7) "Ground Water Monitoring Needs in the Saturated Zone" talk at Land Treatment: A Hazardous Waste Management Alternative, University of Texas, Austin, Texas, April 16, 1985.

8) "Ground Water Contamination: Sources and Remedies" talk at National Environmental Health Association Annual Educational Conference, Water Supply Session, Las Vegas, Nevada, June 23-25, 1985. (paper submitted)

9) "Hazardous Waste Management Strategy in Illinois: Government's Role" talk at International Conference for New Frontier in Hazardous Waste Management, Pittsburgh, Pennsylvania, September 15-18, 1985. (paper submitted)

10) Workshop on "Implementing State Pollution Prevention Programs" sponsored by the Pollution Prevention Program, North Carolina Department of Natural Resources and Community Development, Archdale Building, Raleigh, North Carolina, April 25, 1985.

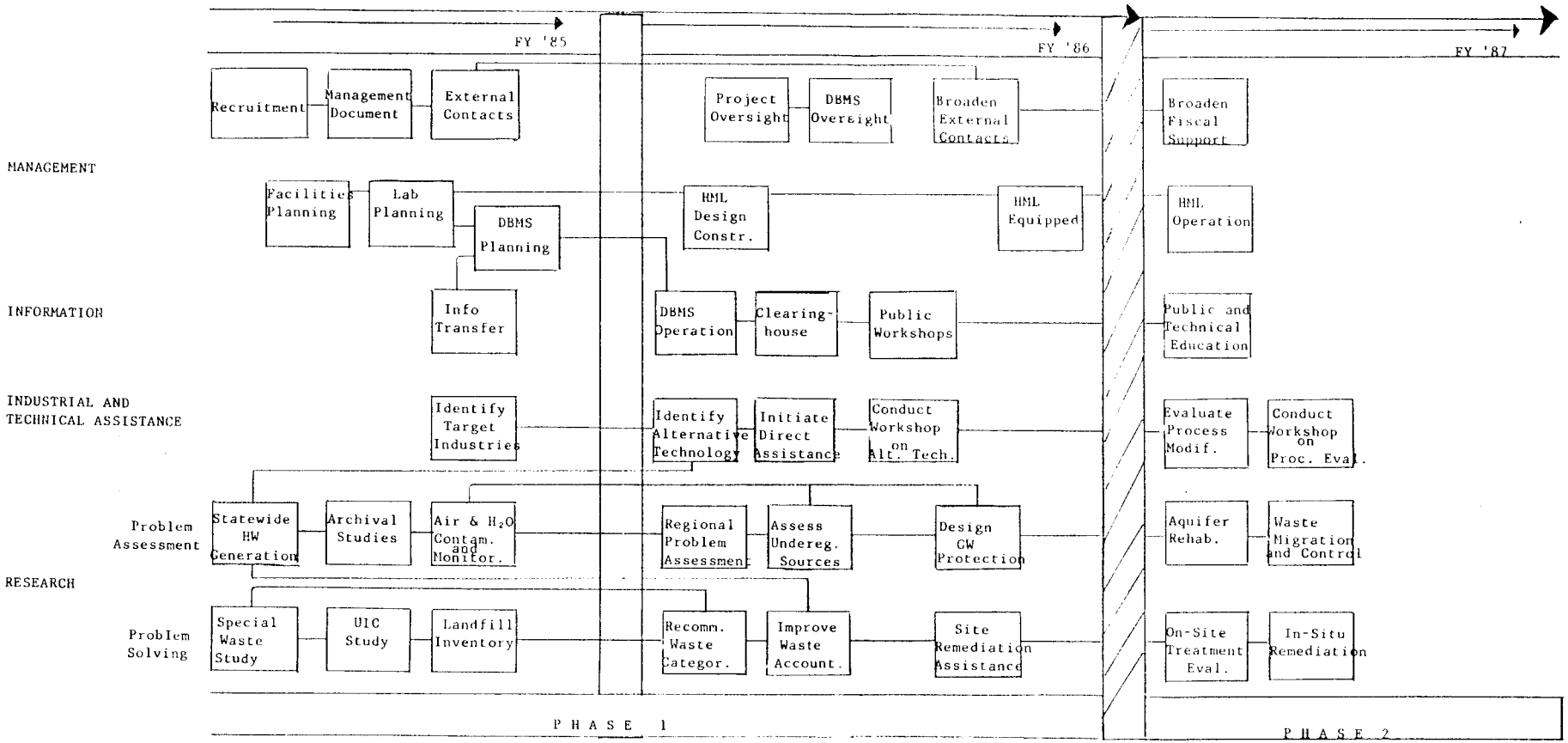

FIGURE 2. Phased Development of HWRIC Programs and Major Tasks

III. RESEARCH ACTIVITIES

Initiation of the Research Program

ENR's hazardous waste research activities were initiated in the spring of 1983 with the creation of the Hazardous Waste Research Fund (HWRF). HWRF is supported by a portion of the fees collected by the state on the amounts of hazardous waste treated or disposed of at commercial facilities. The primary goal of the HWRF was to research critical state problems involved with the generation and management of hazardous waste with an emphasis on alternatives to disposal in or on the land. The HWRF's mission has been assumed by HWRIC with the following general guidelines:

> Research projects directed at Illinois' problems will be supported given that these efforts do not duplicate research ongoing in Federal or other states' programs. Further, the subjects under investigation are not "crisis-oriented", either associated with spills and accidents or situations which more properly are the responsibility of regulatory or enforcement authorities.

Previous projects which have been supported by HWRF have met the general guidelines described above. Clearly, the state cannot presume to support duplicative research given the available support funds. Also, in order to maintain overall program focus, HWRIC must refrain from entering the enforcement or regulatory process except as a source of technical information and advice. The FY'85 projects from the initial HWRIC plan and those recommended by the legislature also fall within the operating guidelines of HWRIC. They are described in detail in the following section under two broad categories:

Problem Assessment

Statewide Hazardous Waste Generation

Optimized Ground Water Monitoring

Regional Ground Water Contamination

Atmospheric Monitoring and Research Needs

Lake Calumet Area Historical Study

and

Problem Solving

Special Waste Categorization

Underground Injection Control

Landfill Inventory

The projects were initiated between September, 1984, and March, 1985, after the screening of prospective contractors and project plans. With the exception of the Statewide Hazardous Waste Generation project, the Lake Calumet Area Historical Study and the Special Waste Study, all of the projects are contractual agreements through the University of Illinois to the Scientific Surveys.

Problem Assessment Research

Statewide Hazardous Waste Generation Study

Essential to a plan for hazardous waste management is the determination of the kinds and amounts of RCRA hazardous wastes and non RCRA wastes with potentially dangerous characteristics generated and/or disposed of in the state. Although there are some records on waste characteristics

and the amounts of such waste generated and disposed of, inconsistencies and gaps in the data need to be identified and corrected. In addition, from the existing information, industries generating large amounts of wastes and the geographic areas in which they are located can be identified.

Tasks associated with the hazardous waste generation study include identification of the location of hazardous waste generators and the gathering of information on their industrial processes; the identification of RCRA hazardous waste stream chemical and physical characteristics; the identification of the chemical and physical characteristics of waste streams which have dangerous properties, but which are not characterized as "hazardous" under RCRA and the rationale for their exclusion; the determination of the magnitude of discrepencies in the existing data through a comparison of reports of generated waste volumes with those volumes manifested for disposal; the identification of Illinois specific waste generation factors that can be used both in economic forecasts and in retrospective analyses; and the identification of industrial processes and industries whose waste products are of major concern based on the quantity, "degree of hazard" as defined in our study on special wastes, persistence, and mobility of their waste stream components.

Progress to date on this project includes the acquisition from one or more sources of the following information: generator I.D., generator name, generator address, generator SIC, authorization number, manifest number, TSD facility I.D., facility permit number, NPDES permit number, air permit number, TSD facility name, type and address, waste type, quantity,

density and handling method, and disposal code. Information on the actual vs. proposed disposal of special wastes for 1982 and 1983 has also been obtained. Computerized "work files" have been established on Illinois generated RCRA waste disposed off-site or on-site in 1982 and 1983 and on RCRA wastes imported to Illinois for disposal in 1982 and 1983. Comparison of the data obtained from different sources is now underway.

The information listed above was obtained from IEPA (annual reports, manifests, Industrial Waste Survey, waste disposal permits, and NPDES permits), and ENR-Franklin Associates report entitled "Liquid Hazardous Waste Streams Generated by Illinois Industries". Sources consulted for possible use in forecasting and retrospective analyses include the 1982 Census of Manufacturers, the 1984 U.S. Industrial Outlook, Predicasts Forecasts, Standard and Poor's Industrial Surveys, the Illinois Department of Commerce and Community Affairs and the Illinois Chamber of Comemrce. Other general sources consulted included the Division of Air Pollution Control database on industrial boilers, the Metropolitan Sanitary District data base on compliance with sewage and waste control ordinance, USEPA RCRA Risk-Cost Analysis Model and RCRA background documents on the listing of hazardous waste.

Members of HWRIC research staff will visit the contractor Raghu Raghavan of Environmental Resources Management (ERM) on April 23 to discuss the findings and further progress on this project.

Optimized GW Monitoring

In response to concerns about groundwater quality, and specifically, the problem of the impact of hazardous materials on groundwater, P.A. 83-1268, (the "Currie Bill") was recently passed. Among its provisions are that the following be undertaken: 1) a study of groundwater quality in Illinois consisting of "a compilation of currently available data . . . and a limited amount of taking of new water samples from existing wells" to assess the extent of contamination of groundwater by hazardous substances; 2) the identification of the location of critical underground resources such as recharge zones and high water tables, with priority given to groundwater quality near hazardous waste facilities; and 3) the establishment of a groundwater monitoring network. This study addresses the above provisions.

Tasks associated with the project were divided into three parts, which correspond with the provisions above. The first task, generally defined as "statewide assessment of groundwater quality", includes the determination of the availability of groundwater quality data, including the assessment of such parameters as ownership of data, access by State Water Survey (SWS) to the data, the form of the data (i.e. whether it is machine readable), the historical period of the data, the water quality parameters included in the data and the amount of data (the number of samples and parameters per sample); the development of contamination criteria and working definitions; the evaluation of the suitability of available groundwater quality data for statewide assessment, including a description of its limitations and recommendations for additional data collection;

development of a presentation format including mapping procedures; compilation and organization of data suitable for statewide assessment; and the determination of "sensitive" groundwater areas based on geological information. New sampling is being done under a different project.

The second task is defined as the identification of hazardous waste "activities" in Illinois. This involves defining the term "activity", obtaining information, and classifying industrial and other businesses on that basis. Factors considered are waste type, disposal method, and county location. A review of available information on historical hazardous waste generation is also a part of this task.

The third task is the development of a statewide monitoring network based in part on the results of tasks one and two. Other facets include a review of literature on the subject, including the O'Hearn-Schock report (Design of a Statewide Monitoring Network for Illinois, SWS contract report 354) as well as the definition of goals and objectives appropriate for a statewide groundwater quality monitoring program. The geologic and hydrologic factors in Illinois that may affect the incidence of hazardous waste contamination and transport in groundwater will be identified and evaluated, and it will be determined whether changes in some commonly available or easily determined water quality parameters, such as pH, may be used as screening devices to flag possible pollution incidents. Finally, specific monitoring requirements will be developed to meet the data needs outlined in P.A. 83-1268.

In addition to the hiring of two new employees, progress to date has included cooperation with IEPA on several matters including a visit by SWS staff to identify data sources and arrangements for the acquisition

of appropriate materials. Conversations have taken place with Ira Markwood (IEPA) to determine what data on organic contaminants has been gathered. Cooperation with USEPA involves an attempt to obtain ERRIS information.

Much of the data obtained is now in computerized form and is accessible by various subjects. For example, a computer routine has been devised to sort information for 21,000 water quality samples from public water supply wells based on aquifer characteristics (sand and gravel, deep bedrock, and shallow bedrock). Overlays will then be prepared showing the locational relationships of known water quality (primarily inorganic) to waste generation and disposal activities, and to population and water use. In addition, information can be pulled from the data base on individual samples on the basis of several different criteria. One criteria would be, for example, an unusually high level of any contaminant. To test the adequacy and accuracy of the data and the format, a test data set was established for Kane county. This involved a comparison of information from various sources.

Trial statistics were generated on each of 27 selected parameters (Alkalinity, B, Cl^-, Cu, Hardness, Mn, PO_4^{3-}, NO_3^-, Se, TSD, Ag, Cd, CN^-, F^-, Hg, Na, NH_4^+, Pb, SO_4^{2-}, Zn, As, Cr, TOC, Ni, Sr, Al and Li). It was found that data were sufficient for the generation of ion balance analyses on 55% of the samples (10,000 of 21,000 taken). Statistics were generated in each of the 27 parameters selected, and tables on distributions and safe drinking water standards were prepared. Experimentation was done on potential methods of identifying trends. One method being considered is the relative percent of high contaminant determinations per year (using data obtained after 1970).

Zip codes were selected as the level of resolution for retrieving data. Production, manufacturing and service activities that may contribute to regional degradation of groundwater quality were identified. Waste treatment storage and disposal facilities will be considered separately. Decisions were made to eliminate some from consideration. For example, in addition to the elimination of those consisting of office space only, gas stations were eliminated while large fuel storage areas were included. Information on the listed "activities" consists of name, address, site location, latitude-longitude, zip code and other available information. The 49,000 "activities" with assigned SIC codes were supplemented by 7,000 which had no assigned SIC code.

To check the accuracy and completeness of the information obtained by methods used in this study, results for two counties (Ogle and Winnebago) were compared with those obtained in a different study (Hazardous Waste in Ogle and Winnebago Counties: Potential Risk via Groundwater Due to Past and Present Activities", by J. P. Gibb et. al., 1983, SWS contract report 366).

Among the documents reviewed for task 2 are "Hazardous Waste in Illinois: An Overview", Document No. 83/17, Illinois Department of Energy and Natural Resources, Springfield, IL, December, 1983; "Management of Hazardous Wastes: An Illinois Perspective", Patterson Associates, Inc., Chicago, IL, August, 1982; HW 84/01 "Development of Detailed Characteristics of Liquid Hazardous Waste Streams Generated by Illinois Industry"; "Ground Water Protection Strategy", USEPA; and HW 84/02 "Pollution to Profit". Information from these reports was used in the identification of hazardous "activities".

IEPA sources consulted include the Illinois Industrial Waste Survey Data (IIWSD), the IIWSD Water File, the IIWSD Land File, the Emergency and Remedial Response Inventory System (ERRIS), the Selected Inventory File, Old Generator Master, the Old Generator Name and Address Master, the Water Quality Standards Master File, Permit Conditions Master File and the Water Quality Analysis Master File. Sources available through NTIS that were consulted for this study are data compiled under the Resource Conservation and Recovery Act (RCRA) and under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). USEPA has provided information from the National Surface Impoundment Assessment for Illinois and the Chicago Municipal Sanitary District has provided their list of Cook County facilities that discharge their waste to sewers.

Progress to date on task 3, the development of a monitoring strategy, includes the hiring of an assistant hydrologist, a search of the National Water Well Association's data base and a summary of the mechanisms associated with groundwater contamination and contaminant transport within the zone of saturation. IEPA has been asked which labs are certified to do organic compound determinations. In order to identify major non-point pollution sources, a search is being done for information to help delineate regions of intense agricultural activity.

Several sources of groundwater quality data have been identified, only some of which were found to be useful for the purposes of this study. The most useful and complete source was data from samples taken from Public Water Supply (PWS) wells. This data consists of 423,359 determinations made on 21,055 samples. Wells were routinely sampled by IEPA for Safe

Drinking Water standard parameters. Listed in decreasing order of number of determinations made, these parameters are Cl, Fe, Alkalinity, Hardness, Mn, F, SO_4, Mg, Na, Ca, Si, NO_3, B, Ba, K, Pb, Cu, Cd, Zn, pH, Ni, Ag, Se, Hg, NH_4, CN, H_2S, CH_4, PO_4, and to a limited extent - determinations made on 10% or fewer of the samples - turbidity, color, odor, CO_2, Li, Sr, Al, NO_2, TOC, TSS, As, Cr. In addition to the advantage provided by the number of samples taken, the location of public wells is verifiable - unlike that of private wells. It was decided that only data collected after 1970 would be used since before that time, monitoring was often problem oriented.

Groundwater quality data from monitoring wells at RCRA disposal sites were also available, but were determined not to be useful as an indicator of regional groundwater quality. It appears that ERRIS data is not readily available. This data does include 65 VOC (volatile organic carbon) and 70 SVOC (semi-volatile organic carbon) determinations. In addition, it was found that Ira Markwood of IEPA had tested samples for organic content from 190 locations representing public water supplies serving populations of over 10,000. In eleven of these samples organic compounds were present. In general, however, it was found that measurements of TOC (Total Organic Carbon) and VOC are minimal and are much needed as indicators of contamination by such substances as organic solvents and petroleum refining wastes.

Other sources identified and found to be of limited value for the purposes of this study are bacterial and nitrate counts for samples collected by the Illinois Department of Public Health; data collected by the Illinois Department of Mines and Minerals (pH, TDS, Alk, SO_4, Ca, Fe, Mg, Na, Cl, NO_3); and information on the IEPA Water Quality Analysis Master File primarily collected from the vicinity of general refuse landfills.

It has been concluded that existing data are not sufficient for determination of regional water quality.

The O'Hearn-Schock report which was written before the "Currie Bill" was passed was assessed to determine whether its recommendations could be applied to the requirements outlined in the "Currie Bill". It was found that, although useful in many respects, it differed from current requirements in that: frequency of sampling was only every 3-5 years, it called for no detailed organic analyses, spatially random sampling was not directed toward specific aquifers or sensitive areas, spatial sample density of one well per square mile (under level II monitoring) may be inadequate in high activity areas, and that the plan was not directed toward data gathering, only PWS wells were used.

It was also found that the Soil Conservation Service (SCS) has data on the percent of each county in cropland. This information can be used in identifying non-point sources of pollution.

Cost estimates from the five labs certified to do organic analyses (Gulf Coast Laboratories, Inc., University Park, Aqualab, Inc., Bartlett, Daily Analytical Labs, Peoria, Belleville Labs, Belleville, St. Louis County Water Co., Chesterfield, MO) will determine the number of samples that can be processed.

Hazardous substance activities maps based on separate SIC codes, water use maps, and sensitive aquifer area maps are being evaluated to locate potential target areas for the recommendation of a monitoring strategy. A summary of ERRIS sites, by county, was mapped to describe the amount of remedial and emergency response activity. Comparison of

this map with maps of hazardous substance activities reveals that the preponderance of environmental response has taken place in areas of high hazardous substance activity (e.g., the 5 northeastern Illinois counties and the East St. Louis area).

Regional Groundwater Contamination

In conjunction with the Optimized Groundwater Contamination study, a small scale groundwater testing program, designed to complement that being carried out by IEPA, is needed. Current groundwater monitoring is designed primarily to detect inorganic contaminants. Although inorganic contaminants are a common problem in surface water, they are a less frequently encountered (although potentially serious) problem in groundwater due to the limited transport of heavy metals under many geological conditions. The most frequently encountered contaminants of groundwater are organic compounds, most of which originate as industrial solvents and refined petroleum products.

Therefore, a plan than can identify increases in TOC (total organic carbon) that might be indicative of the contamination of groundwater by organic pollutants, is desirable. In order to carry out such a plan, it is necessary to first establish background levels of TOC in undisturbed groundwater. Little information currently exists on the subject, although it is known that TOC in surface water is typically two to three times greater than it is in groundwater. In addition, it is known that while volatile organic compounds (VOC) may constitute up to half the TOC in groundwater, in surface water their percentage is much less.

Since VOC's are the most frequently observed contaminants in U.S. groundwater, a reliable method for their detection is needed. Specific tasks in the establishment of an organic compound reconnaissance program include: the screening of split samples collected by IEPA (in conjunction with their Public Water Supply monitoring network) for TOC and VOC (12-15 month initial phase); the completion of more intensive sampling from areas of high industrial, and hazardous waste treatment, storage and disposal activities; the sampling of control areas to establish background data; the performance of more detailed analytical investigations in areas adjacent to public water supply well fields that show significantly higher organic compound levels than ambient levels; and the interpretation of results both locally and regionally to provide a basis for the recommendations concerning future monitoring.

Progress to date on this project includes the acquisition of a TOC instrument, and the construction of four flow through devices designed to measure pH, Eh (oxidative potential), T (temperature), and Ω^{-1} (conductivity). Personnel at IEPA and USGS have been trained in the operation of these devices.

It has been decided that IEPA will test for phenols, base/neutral compounds, and will scan for VOC. SWS will also do a VOC scan and will test for TOC.

Atmospheric Measurement of Hazardous Constituents

Incineration is an alternative disposal option to landfilling for many persistent, hazardous organic solvents and complex mixtures. Illinois has several incinerators which are permitted for the destruction of various hazardous waste streams which have sufficient heating value or are simply too toxic or expensive for land disposal. Permitting requirements vary substantially from state to federal permitting agencies and the result is that current incineration capacity is grossly under-utilized. Low temperature boiler destruction of solvent or metal containing wastes is currently used, despite the fact that it is frequently illegal. These sources of atmospheric emissions are not well characterized as to flue characteristics, gross emission loadings and residues in the ash. There is very little information on the waste management future. Research at the Federal level clearly emphasizes thermal destruction techniques for hazardous waste management.

Health effects of airborne combustion wastes will depend on the phase (gas or solid) of the wastes as well as particle size, which determines the degree of penetration of waste particles into the lung. The environmental fate and pathways of these materials will also depend on both gas/solid partitioning and particle size distribution, because both wet and dry atmospheric deposition processes are heavily dependent on such parameters. Thus, data on the gas/solid partitioning and the particle size distribution of toxic materials are needed for assessment of both health and environmental effects of hazardous waste combustion.

The primary research tasks of this project are, over a three year period: the review of literature on hazardous waste incineration in the

state, identifying major waste streams, modes and locations of incineration, and the probable air pollutant and waste residues that result from their operation; the development of suitable sampling methods for the ambient monitoring needs of the state; and establishment of a pilot monitoring network to supplement the current regulatory atmospheric effort.

The tasks for the first year's study include the review of the current status of hazardous waste incineration in Illinois, the review of measurement methods for airborne and source hazardous waste management, and the survey of solid-phase airborne metal concentrations in Illinois.

In the second year, routine measurements of solid-phase metal concentrations and the development of methods to measure a limited number of gas-phase metals will take place. In addition, measurements will begin on both gaseous and solid phases of a few hazardous organic materials.

In the third year, it is expected that the routine measurements of gas-phase metals will continue, and the organic compound monitoring program will be expanded.

Activities to date associated with this project have included the hiring of a chemist, Dr. Clyde Sweet; attendance at the Air Pollution Control Association Workshop on Hazardous Waste Incineration; meetings with IEPA staff members (Bob Hutton and Terry Sweitzer of the Ambient Air Monitoring Section and Jim Cobb of the permitting section); and the acquisition of several reports (Illinois Environmental Protection Agency, 1983: "An Evaluation of Hazardous Waste Incinerators in the State of Illinois", and E. Keitz, G. Vogel, R. Holberger, and L. Boberschmidt, 1984: "A Profile of Existing Hazardous Waste Incineration Facilities and Manufacturers in the United States").

It has been found that monitoring for metals is done at at least 48 sites in Illinois. The locations include Chicago, suburban Cook County, Peoria, Elmhurst, Elgin, Braidwood, Joliet, East Moline, Granite City, Wood River, East St. Louis, Rockford, Carbondale, Decatur and Nilwood. Much of the monitoring is done by IEPA but some is conducted by county governments. IEPA monitors Pb, As, Be, Cd, Cr, Mn and Fe. Fewer metals are monitored by the county programs. Particles are not separated by size, and there is no information on gas/solid partitioning. A tape with data from 1978-1984 has been acquired. It will be analyzed for basic statistics, seasonal variability, temporal trends and the spatial distribution of annual means. Only a very limited amount of sampling is now being done for organic compounds. IEPA samples at two locations near the SCS incinerator in South Chicago. As with metal monitoring, no attempt is being made to analyze gases and solids separately. USEPA is establishing a clearinghouse for information on airborne toxic substances. This may prove to be useful in the assessment of sampling and analytical methods.

Based on material found in the published reports mentioned above, which are, in part, a compilation of information received in "part A" permit applications, 76 facilities have been identified that may be incinerating hazardous wastes in Illinois. A list of waste streams that may be incinerated at each site is also available, although there is little information on the types of incinerators.

In summary, work thus far has confirmed that there is a need for information in Illinois on 1) airborne concentrations of toxic organic materials and on their particle size distributions and gas/solid partitioning

and 2) on size distributions and partitioning of metals. The proposed tasks over the next three years are designed to meet these needs.

Lake Calumet Historical Perspective

Hazardous wastes have been generated in certain parts of the state, especially the region around Chicago, since the 1860's. In the Calumet Lake area, steel mills and founderies were active in the 1880's, after the Calumet River was dredged to make it navigable. At that time, the hazards associated with industrial waste were generally unrecognized, and regulation was non-existent.

The anticipation of waste disposal related tragedies, such as those that have come to public attention during and since the Love Canal disaster, and the direction of cleanup efforts, require knowledge of the history of industrial activity before stricter regulations came into effect in the 1970's. Therefore, a historical study of the Calumet Lake region has been undertaken. A goal of the research, in addition to the compilation of specific information on one location, is the establishment of a methodology that can be used to assess the industrial history of other urban areas.

Specific tasks associated with this study are: the development of a history of the Lake Calumet area covering general aspects of its settlement, growth, and human use; the development of a history of manufacturing operations including a determination of processes and dates of operation; the identification of waste types and location of disposal; and the determination of the subsequent history of disposal sites.

Sources that have been consulted to date include the Chicago Historical Society, the Pullman Historical Foundation, the Corps of Engineers - Division

and District Offices, Commonwealth Edison, Illinois Factory Inspection Records, Chicago Regional Port District Records, Chicago Plan Commission newspapers and periodicals, as well as long time local residents.

Several primary sources proved to be extremely valuable. Among them were records of the U.S. Army Corps of Engineers, the Metropolitan Sanitary District and the Federal Court System. However, several potentially valuable sources were not made available for this study. There was, for example, only poor response to an industry questionnaire, and responses received indicated that records were not kept. Municipal records, interestingly, were also unavailable, and there were conflicting reports from staff members as to their whereabouts or existence. It is hoped that cooperation from such entities can be secured before other historical studies are attempted.

In spite of such problems, a chronology of industrial activity and waste disposal from 1869-1970 has been developed. It has taken into consideration legal, technical, and economic factors that have affected levels of production and disposal methods. It is felt that the methodology applied in this study can be adapted to other localities.

Problem Solving Research

Special Waste Categorization

In Illinois, "special wastes" are loosely defined to include not only hazardous wastes, as defined in RCRA, but also "Industrial Process Wastes" and "Pollution Control Wastes" (defined in 35 IL Admin. Code section

809.103). The designation is meant to indicate that such wastes may require special treatment or handling. The problem is that some special waste streams (excluding hazardous RCRA wastes), are innocuous, consisting of, for example, nothing more than "salad oil and Miracle Whip", while others are, in fact, dangerous enough to require special handling.

Recent legislation (the "Currie Bill" - P.A. 83-1268) addressed this problem, requiring a special waste categorization study that, at a minimum, was to include "an assessment of the degree of hazard of special waste streams generated in the state, alternative systems for classifying these wastes according to their degree of hazard, an evaluation of the benefits of assessing hazardous waste fees, and developing storage, treatment and disposal standards based on such classes of wastes". The special waste study addresses those topics.

The major tasks of this study are: the review of existing regulations (both state and Federal) pertinent to the management of special wastes in Illinois; the development of a comprehensive listing of non-RCRA special waste streams in Illinois; the development of alternative methods for assessing the degree of hazard for waste streams; the assessment of the degree of hazard of special waste streams, based on the methodology developed in this study; the proposal of appropriate storage, treatment and disposal methods for special waste streams; and the evaluation of the benefits of assessing hazardous waste fees.

The review of regulations is currently in progress. With regard to the listing of special wastes, it was found that although there are disposal permits for 8,704 non-hazardous special waste streams, there are manifests

for only 2,964 of these. (A waste disposal permit is an application submitted by a waste generator to IEPA for permission to dispose of a waste stream at a given site. A generator may file applications for disposal at several sites for a particular waste stream. The application contains information about the waste stream. The manifest is a document that accompanies the waste stream when it is disposed of.) Since multiple applications may exist for each waste stream, but manifests should reflect more accurately the actual volume of waste streams, it was decided that the 2,964 waste streams represented by the manifests will be defined as active waste streams. The information for each waste stream that is contained in these documents includes the generic waste name, the process name from which the waste was generated, the principal components contained in the waste stream including their proportions expressed as a percentage; toxicity expressed in relative degree (high, medium, or low), pH, and flash point. Information on heavy metals contained in the documents was believed by IEPA to have little value, and probably will not be useful in this study.

Of the 2,964 active waste streams, it was decided that approximately 250 that were deemed to be characteristic will be assessed for "degree of hazard". They were selected on the basis of high volume, relatively high toxicity or relatively innocuous properties.

A design for the degree of hazard assessment procedure has been created. It is the result of the review and assessment of over 20 different classification systems. The design consists of three steps. The first step is a decision tree that, on the basis of certain characteristics, will serve to eliminate the more harmless wastes. The second step consists of a matrix in which

dangerous properties (such as acute or chronic toxicity, carcinogenicity, mutagenicity, teratogenicity, persistence, bio-accumulation, exposure potential and characteristics of initiability, corrosivity and reactivity) will be indicated for specific components of the remaining waste streams. The third step is a flow chart that will indicate the total degree of hazard of a waste stream based on the additive properties of its various components.

The assessment of fees may include consideration of the "degree of hazard" assigned to a waste stream. A literature search is continuing on this subject.

A subcontractor (Battelle) has been selected from among seven applicant firms, and engaged to conduct the study on appropriate waste treatment and disposal methods.

Underground Injection Control

Underground injection is the process whereby liquid wastes are injected under pressure via a well, into porous rock (such as sandstone, limestone or dolomite) which is confined above and below by layers of more solid rock (such as shale or slate). The water contained in aquifers selected for this process is of "low quality" (more than 10,000 mg/l total dissolved solids) and so is not a candidate drinking water source. Underground injection has been used as a disposal method for at least 40 years, but has been regulated only since 1965.

In 1983, 307,300,000 gallons of industrial wastes were disposed of by this method. Industrial acids (HCl and HF) were the most common constituents

of the waste streams. Other important constituents include pesticide wastes, etching wastes (nitrates and phosphates), starches, fluoride, mercury, chromium, Stretford process wastes, chlorinated hydrocarbons and runoff from plant property.

All nine of the waste injection wells in Illinois are regulated the IEPA as Class I wells under the Underground Injection Control (UI program of the Safe Drinking Water Act. Class I wells are those in w waste is injected "below the deepest underground source of drinking w

The assumption, on which the entire justification for the use of this technique rests, is that wastes, once injected, will not migrate from the designated aquifer. Potential problems associated with this method of disposal include the fact that the horizontal migration of in aquifers is very poorly understood. In addition, injection pressu may cause fissures in rock, and well casings may crack at the level c an aquifer used for drinking water.

A recently passed amendment to the Environmental Protection Act Rev. Stat., ch. 111½, sec. 1006.2) directs the Department of Energy Natural Resources to conduct a study designed to determine whether underground injection is an appropriate method of waste disposal. The legislation specifies that the study shall include 1) "an evaluation of current practices involving underground injection in Illinois including the volume and of wastes injected"; 2) "a review of existing studies concerning deep well injection and an evaluation of the safety of underground inject as a means of disposing of hazardous waste, including possible risks

groundwater supplies and thus to the public health and safety"; 3) "an evaluation of the alternative technologies which could be utilized to handle hazardous wastes if underground injection were banned and of the relative risks to the public health and safety of these other methods, compared to underground injection"; and 4) "recommendations as to whether . . . other technologies pose less risk to the public health and safety and whether underground injection of hazardous wastes is an appropriate disposal technique for use in Illinois and whether additional restrictions should be imposed on current practices".

Tasks for this study have been designed to fulfill the requirements of this act. The current Illinois Pollution Control Board (IPCB) regulations and Illinois Environmental Protection Agency (IEPA) regulatory practices will be reviewed. Included in this review will be a determination of the adequacy of data in the permit applications and current monitoring and well construction practices. An historical evaluation of the operation and maintenance history of underground injection facilities in Illinois will include evaluation of waste type, volume and homogeneity with time. An assessment will be made of the risk to the public posed by the injection facilities, and the storage facility. A review of other states' experience with underground injection will be conducted. In addition, a summary will be made of available geologic information in Illinois to determine whether enough information or scientific evidence exists to designate any geologic formations as waste repositories. A related activity is the assessment of economic and environmental trade-offs involved in reliance

on underground injection versus pretreatment and/or other modes of hazardous waste management.

The review of regulatory procedures at IEPA has now been completed. It covered the topics of procedures for filing permit applications, application handling procedures, provisions for permit modification and revocation, and standard and special conditions. The review identified one minor point of questionable interpretation concerning injection pressure limitation and a recommendation for change has been made. Progress on the historical evaluation task has included the division of the waste streams identified into three categories: a) strong alkaline wastes with chlorinated organic compounds, b) very acidic wastes, and c) moderately acid wastes. It was found that category (b) wastes represent the largest waste volume injected in Class I wells. Data have been compiled on general well construction specifications, geologic units penetrated by each well, and the total dissolved mineral content of selected water yielding units. Parameters have been identified that affect the movement of pollutants in an aquifer.

In order to evaluate the potential for contamination from surface spills associated with underground injection operations, the character of the upper 50 feet of earth materials and the capacity of these materials to control fluid movement are summarized for each site and evaluated for potential impacts to nearby public water supply wells and aquifers used as sources for drinking water. The evaluation of the potential for contamination of the subsurface environment from leakage through or around the well was assessed through the review of well construction procedures, materials used in construction, and review of testing done both during construction

and periodically throughout the life of the well. The review of underground injection practices in other states has involved telephone contacts and site visits. It appears that the use of underground injection as a waste disposal method is declining or stable, although in many areas there are isolated cases of interest in developing new Class I wells. In general, other regulatory agencies have been enthusiastic about the exchange of information on underground injection control practices.

Available geologic information will be summarized as it pertains to delineating areas and formations which might be targets for future injection activities and barriers (cap rock) to vertical migration of waste fluids. Data for this task have been compiled and are now being summarized in written form along with a series of applicable maps. Illinois has one or more potential disposal zones for small to moderate size waste streams throughout most of the southern 3/4 of the State. Within selected areas of this region of the State potential disposal zones exist for accepting larger waste streams. In the north an inadequate barrier (cap rock) exists above potential injection horizons and in this region of the State waste disposal in Class I wells will not meet the requirements of the UIC regulations.

Environmental and economic tradeoffs will be identified and evaluated for alternative technologies (pretreatment or other modes of hazardous waste management) for disposal of liquid wastes in UIC facilities. Work on this task is in progress with the consultant-contractor, Engineering-Science, Inc.; Mr. Mark Guthrie is conducting the investigation. A preliminary report is scheduled for the early part of April.

Landfill Inventory

In order to access the magnitude and extent of the hazardous waste problem in Illinois it is necessary to have information on all landfills in the state - those that are now closed as well as those that are currently in operation. Before "hazardous wastes" were defined as such, materials we now know as hazardous may have been disposed of at many different landfill sites throughout the state. The purpose of this study is to compile information on each currently or formerly used site. Specific tasks are the identification of such sites, and for each, a description of their location, type, hydrogeologic setting, waste sources, and background data (site history, previous studies, and record of operation and monitoring). In addition to a final report, various maps will be prepared to summarize the information compiled. No on-site evaluations will be performed at this time.

Sources obtained from IEPA during a site visit are the report "Inventory and Assessment of Surface Impoundments in Illinois (1980)"; and a copy of the FIP's code, which is used to assign disposal site numbers.

A preliminary computer format has been set up for the storage of information in the INFO data storage system of the Illinois Natural History Survey's Prime 750 computer. It has been decided that the scale for the basic map showing the distribution of waste disposal sites in Illinois will be 1:500,000 so that it can be readily compared with the many other existing maps at that scale. Special smaller scale maps can be prepared for areas with a large concentration of data points. A set of map symbols, which can be produced by the computer, has been developed to identify six parameters related to disposal activities. These parameters are used

to form a matrix. On the horizontal axis are parameters indicating general categories of waste (hazardous, non-hazardous, and unknown). On the vertical axis are parameters describing the type of disposal (burial, impoundment or land application).

The computer format contains elements capable of generating a map of the areal distribution of all disposal sites in Illinois, and is capable of generating as many as 16 different maps based on separate attributes or combinations of attributes of disposal activities. Test printouts for two counties have now been completed.

Although available information is limited, this project will identify sites that will need additional study and the relative priority of future sites for study as well as estimates for the time and cost requirements for such studies.

IV. Developing Activities and Future Plans

The progress of HWRIC management and research program activities has been supported largely by the existing staff of ENR's Divisions and external contractors. Now that the recruitment process has been completed, the products of the research projects will be very useful to new staff in the planning and future development of HWRIC's programs. This concluding section describes the current status of the Industrial and Technical Assistance and Information Programs together with a preliminary overview of research tasks which will further HWRIC's capability to address critical hazardous waste management problems in Illinois.

Industrial and Technical Assistance Program

This program will eventually provide the most important outlet for the application of alternative management options for hazardous waste streams in the state. Supported by the products of the problem assessment research projects, the staff will be able to focus their engineering expertise on the most immediate problems of responsible waste handling treatment and disposal. It is anticipated that direct support will be supplied to aid industry in meeting the mandates of the solid and liquid hazardous waste landfilling bans in a systematic fashion.

Currently, the coordinator of this program is involved in the design and implementation of engineering assistance efforts. A questionnaire has been developed to poll industries and commercial generators of hazardous waste on their immediate problems, as well as the type and extent of assistance which is needed. The format of the questionnaire is short and straightfoward to encourage maximum return rate. Also, distribution of the form is planned to include information on HWRIC's structure and goals to the five to six thousand generators of hazardous waste in the state. A subset of this large group of generators will be contacted directly with an emphasis on the eleven to twelve hundred major facilities which account for nearly 90% of the hazardous waste included under the state RCRA program.

This program is developing rapidly and will seek the advice of the Advisory Panel and Governing Board representatives as it progresses.

Information Program

The transfer of reliable information on the nature of and solutions to Illinois hazardous waste problems to a wide constituency is an essential part of HWRIC activities. As yet, the core staff has not been assembled. Interim staff and the support of contractors have begun this activity. The preliminary design of a data base management system and the production of an informational brochure have been the principal products of the effort to date. The results of the first year research effort will also be printed and distributed in the coming months.

Research Planning and Overall Program Development

The basis of an effective, technical support effort in government waste or natural resource management must rest on sound information. The initial planning activities of the HWRIC program, which began in the fall of 1983, clearly identified the need to evaluate state and federal regulatory information bases as well as both the engineering and scientific literature. From the outset, it was obvious that much of the available data on generation, handling, treatment and disposal operations was previously collected for regulatory purposes. This severely limited the extent to which HWRIC's initial research, information and assistance activities could be focussed on the most critical areas of need in Illinois.

The situation has improved somewhat judging from the initial products of the research effort. However, we are still on a rather steep "learning-curve" and long range planning cannot be extended reliably beyond a two to three year time frame. This is not to say that the mission or goals of HWRIC's programs will change. It is rather a cautious statement that the limited resources currently available to the program must be focused on the most obvious problem

areas which are presently recognized. In general, three main research areas of emphasis must be pursued until we have had sufficient time to interpret the initial products of the research investigations currently underway. These areas are:

Accounting of hazardous waste management practices

Illinois' profile of waste generation, sources, types and volumes represent a microcosm of the national picture. The largest categories of generation are clearly associated with the chemical, petrochemical, metal-finishing and manufacturing industries in the state. Therefore, from an estimated set of four to five thousand potential hazardous waste generators, a subset of roughly twelve-hundred generators account for more than 90% of the off-site managed waste tracked by the regulatory programs. Estimates of the fraction of the total waste volume generated, which are manifested off-site, range from less than 25 to over 70%. This estimate must be improved in order to better assess the extent of current hazardous waste generation related problems in the state. Waste stream composition, treatment or disposal practices, as well as alternatives to disposal in or on the land, must also be further investigated to supplement the work completed by the contractor in June. These lines of analysis are essential to the research and industrial assistance efforts if they are to address the state's present problems.

Based on the accounting and waste stream characterization results, the past history of waste generation and management should be evaluated. This area of research is important to identify the required areas of the state which demand more close attention as to waste releases to the air, water and soil environments. The retrospective analysis procedures have been touched upon in past HWRF supported projects and should be developed and applied in considerably more depth to better assess the consequences of past and present waste management practices.

Evaluation of the environmental consequences of hazardous waste management practices

A parallel effort of in-depth investigations of the environmental consequences (i.e. air and water resource impacts) of past waste management practices should be maintained along with the accounting efforts described above. Efforts to assess the research and monitoring needs for both air and water routes of exposure to humans as a result of waste releases have been initiated this year. The most serious gaps in our understanding arise from the difficulties in assessing the impact of on-site or undiscovered site waste releases to ground-water and the lack of data which would link site-specific monitoring results with those from the ambient ground-water quality data bases. The landfill inventory effort should be expanded to better define the universe of potentially serious situations resultant from both land disposal and impoundment operations. Clearly, if HWRIC is to complement the extensive programs in environmental toxicology and hazardous substance epidemiology conducted by the IEPA and IDPH, we must develop the predictive capability to assess the relative hazard associated with likely routes of exposure.

Evaluation of remedial action and cleanup strategies

Currently, the state has assumed cleanup responsibility for a large number of past sites of hazardous waste generation or management activities. Responsible cleanup actions demand that the enormous outlay of funds and resources results in a reasonable level of prevention or mitigation of future environmental or public health impacts at each site. A framework for the evaluation of potential remedial action options suitable for site cleanup or on-site treatment operations must be developed. Since the state finds itself in the position of becoming a major generator of wastes by virtue of its cleanup responsibilty, the technical support of HWRIC and ENR should be made available to find suitable solutions to recognized problems. These efforts should seek solutions, rather than extended

studies, of how a particular site failed. The emphasis should be identifying both contaminant release or plume characteristics , as well as, the means to cleanup and monitor the efficiency of mitigative actions.

These primary areas of research will support HWRIC activities and those of our sister agencies involved in hazardous waste related issues in the next two to three years. As the information base improves, specific projects should be undertaken to more carefully define the environmental and public health research and service needs towards a comprehensive waste management strategy for Illinois.